

REMARKS

Newly presented Claims 23-26 are directed to specific embodiments of the present invention. That is, newly presented Claims 23 and 24 limit the catalyst to consisting essentially of or consisting of iron and the active carbon. Newly presented Claims 25 and 26 limit Claims 5 and 22 respectively in requiring that the active carbon has not been subjected to a phosphorus treatment. No new matter has been added.

Claims 5, 6 and 8-22 have been rejected under 35 USC 103(a) as being unpatentable over Sudhakar et al in view of Hisamura et al and Olah et al. Claim 7 has been rejected under 35 USC 103(a) as being unpatentable over Sudhakar et al in view of Hisamura et al and Olah et al and further in view of Adams et al. Applicants respectfully traverse these grounds of rejection and urge reconsideration in light of the following comments.

As discussed previously, the instant invention is directed to a method of hydrocracking a heavy oil which includes at least one of asphaltene, residual carbon, nickel and vanadium in a reactor. The method comprises the steps of contacting the heavy oil with a catalyst comprising iron and active carbon having an MCH conversion rate of 40-80%, specific surface area of 600-1,000 m²/g, pore volume of 0.5-1.4 cm³/g, 2-50 nm mesopore volume of not less than 60% and average pore diameter of 3-6 nm. The iron is carried on the active carbon in an amount of from 1-20 wt.% with respect to the active carbon.

In the embodiment of the present invention described in Claim 22, two hydrocracking steps are performed in which the first step is conducted at a lower temperature than the second step. This process helps to prevent the generation of coke due to the hydrocarbon radicals being controlled in the first step and polycondensation between the hydrocarbon radicals being suppressed.

The instant invention is based on the discovery that the claimed catalyst can be used in the hydrocracking of a heavy oil containing impurities such as at least one of asphaltene, residual carbon, nickel and vanadium and yet still produce a hydrocracked product containing a lower amount of nickel and vanadium while preventing coke from being generated in a side reaction during the hydrocracking. The heavy oil feed can additionally include a heptane-soluble matter in an amount of from 9-30 wt.%, nickel and/or vanadium in a total amount of from 200-1,000 parts per million by weight and fractions having a boiling point not lower than 525°C in an amount of 70-100% by volume. In the present invention, the catalyst does not become deactivated due to impurities contained in the heavy oil, such as aroma, nitrogen compounds, asphaltene and heavy metals such as nickel or vanadium, and the generation of coke is suppressed. It is respectfully submitted that the presently claimed invention clearly is patentably distinguishable over the prior art cited by the Examiner.

The Sudhakar et al reference discloses a process for the pretreatment of a hydrocarbon feed containing sulfur and nitrogen compounds in aromatics prior to hydrocracking or fluid catalytic cracking. The process comprises a step of contacting the feedstock with a sulfided catalyst comprising a metal of non-noble Group VIII and Group VIB, and, optionally one or more elements selected from Group IIIA and Group VA of the Periodic Table on a carbon support consisting essentially of activated carbon and, optionally, on a carbon support treated with phosphorus.

As pointed out by the Examiner, there are many aspects of the presently claimed invention that are not shown by Sudhakar et al. One aspect of the present invention is that the active carbon in the catalysts have an MCH conversion rate of 40-80%. The lower limit of 40% with respect to the MCH conversion rate of the active carbon is critical in that if the MCH conversion rate is less than 40%, the catalyst would have a lower hydrocracking activity. This would result in a decrease of

the conversion of 525°C+ and the production yield of the target light oil is also lowered. It is known that the pretreatment of active carbon by an acid gives it a large MCH conversion rate. Since the Sudhakar et al reference shows that the active carbon is treated by phosphoric acid, the active carbon of Sudhakar et al should have an MCH conversion rate greater than 80%. As such, nothing in Sudhakar et al suggests the criticality of the claimed MCH conversion rate of from 40-80%.

In order to establish the criticality of the claimed MCH conversion rate, Applicants are enclosing herewith a Declaration Under 37 CFR 1.132 in which the reaction results of active carbon catalysts having varying MCH conversion rates are tested. As shown in Table A and the graph contained in the enclosed Declaration Under 37 CFR 1.132, the claimed MCH conversion rate of 40-80% provided the hydrocracking process with an unexpected improvement with respect to the suppression of coke generation while maintaining a high conversion of 525°C+. This is clearly unexpected in light of the disclosure of Sudhakar et al and patentably distinguishes the presently claimed invention thereover.

It is to be noted that the Sudhakar et al reference requires that both a non-noble Group VIII and Group VIB metal be present as part of the catalyst composition. Currently pending Claims 6, 15, 23 and 24 expressly exclude the Group VIB metal therefrom. This reference has no disclosure that anything advantageous would occur or that the catalyst would even function by using only iron as a catalytic metal. Moreover, this reference has no disclosure with respect to the catalyst being deactivated from impurities contained in the feedstock such as heavy metals, nickel, vanadium or asphaltene because the feedstock specifically disclosed there is a gas oil which does not contain these impurities. The catalyst of Sudhakar et al is an acidic catalyst having a high hydrocracking activity for reducing aroma and nitrogen for gas oil, which only has a low content of basic impurities. The

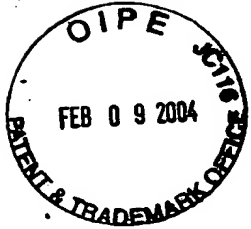
catalyst of Sudhakar is acidic and would not be effective in the hydrocracking of heavy oils having basic compounds in a high concentration, such as aroma, nitrogen compounds, asphaltene and heavy metals such as nickel or vanadium. Moreover, as shown in the Declaration Under 37 CFR 1.132, the catalyst of Sudhakar et al having a high MCH conversion rate would generate a large amount of coke during the hydrocracking of heavy oils containing the above-discussed impurities.

The secondary references cited by the Examiner are said to show specific features of the present invention not shown by the primary Sudhakar et al reference. That is, Hisamura et al has been cited to show a catalyst having an MCH conversion rate of from 40-85%. However, that conversion rate is specific to the catalyst composition disclosed in Hisamura et al and given that the catalyst composition of Sudhakar et al probably has an MCH conversion rate greater than 85%, to modify the catalyst composition of the primary reference to have the MCH conversion rate disclosed in Hisamura et al would go against the teachings of the primary reference. Therefore, such a combination as suggested by the Examiner is not available.

The Olah et al reference has been cited as disclosing asphaltene as a constituent of heavy oil. However, this does not correct the deficiencies contained in the previously discussed references and therefore would not make a showing of prima facie obviousness under 35 USC 103.

The Adams et al reference has been cited as showing that sulfiding is a known technique for increasing the activity of hydroprocessing catalysts. However, as discussed above, this reference does not cure the deficiencies contained in Sudhakar et al and Hisamura et al with respect to the claimed MCH conversion rate and the exclusion of all metals except iron from the initial catalyst composition. Therefore, it is respectfully submitted that the presently claimed invention clearly is patentably distinguishable over the prior art cited by the Examiner.

The Examiner is respectfully requested to reconsider the present application and to pass it to issue.



Respectfully submitted,


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